Aerogel Microspheres

A new form of aerogel for filtration and adsorption

Monolithic aerogels are ideal for applications such as transparent window insulation, but the expensive processing equipment necessary to produce these large aerogels has limited their commercial appeal. Aerogel microspheres offer an attractive alternative because they can be produced in a semicontinuous process.

Silica microspheres have been produced commercially, and their thermal performance is known. Air-filled, thermal conductivities for monolithic aerogels are 12 mW/m·K; for silica microspheres, they are 20 mW/m·K.

Resorcinol-formaldehyde (RF) and melamine-formaldehyde (MF) microspheres should have even better thermal properties because their solid conductivity is lower than that of silica. RF microspheres can also be pyrolyzed in an inert atmosphere to produce carbon aerogel microspheres with properties different from those of conventional carbon blacks.

Advanced synthesis techniques

We use an inverse emulsion polymerization to produce the aerogel particles we call microspheres. By varying the emulsification procedure, we can produce microspheres ranging in size from micrometers to millimeters. We have synthesized RF, carbon, and MF microspheres. In a two-step process, we also synthesized silica microspheres from the hydrolysis and condensation of tetramethoxy silane. These silica microspheres are optically clear and more transparent to visible light than commercially available products.

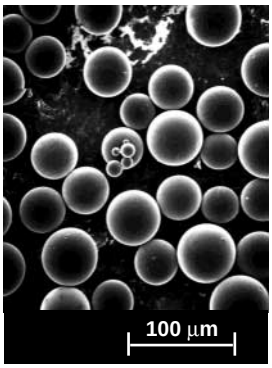
We also developed a process for making hollow, silica aerogel microspheres for applications in inertial confinement fusion. This proprietary process forms the microspheres and cures the aerogels simultaneously in free fall.

APPLICATIONS

- Additives for conventional foaming operations
- Chromatographic packing materials
- Controlled release agents
- High surface-area adsorbents

Characterization

The accompanying figure shows a scanning electron micrograph of carbon microspheres. Although the aerogel structure within the microspheres cannot be delineated, it is clear that the particles are spherical with smooth surfaces.



Scanning electron micrograph of carbon aerogel, 300×.

Gas adsorption measurements reveal the microspheres to have cell–pore sizes greater than 100 nm and surface areas from 400 to 1100 m^2/g—similar to those of their monolithic counterparts. The solid matrix within the aerogel microspheres is composed of interconnected colloidal-like particles or fibers with characteristic diameters of 10 nm.

Availability: Aerogel microspheres are available now. We are interested in collaborating with industrial partners on the scale-up and production of aerogel microspheres for commercial applications.

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